

Changes in Jump-Down Performance after Space Flight: Short- and Long-Term Adaptation

I. S. Kofman,¹ M. F. Reschke,² J. M. Cerisano,¹ E. A. Fisher,¹ E. L. Lawrence,¹ B. T. Peters,¹ and J. J. Bloomberg²
¹Wyle Integrated Science and Engineering Group (1290 Hercules, Suite 120, Houston, TX 77058, USA) and ²NASA Johnson Space Center (2101 Nasa Parkway, Houston, TX 77058, USA).

INTRODUCTION

Successful jump performance requires functional coordination of visual, vestibular, and somatosensory systems, which are affected by prolonged exposure to microgravity. Astronauts returning from space flight exhibit impaired ability to coordinate effective landing strategies when jumping from a platform to the ground. This study compares the jump strategies used by astronauts before and after flight, the changes to those strategies within a test session, and the recoveries in jump-down performance parameters across several postflight test sessions. These data were obtained as part of an ongoing interdisciplinary study (Functional Task Test, FTT) designed to evaluate both astronaut postflight functional performance and related physiological changes.

METHODS

Six astronauts from short-duration (Shuttle) and three from long-duration (International Space Station) flights performed 3 two-footed jumps from a platform 30 cm high. A force plate measured the ground reaction forces and center-of-pressure displacement from the landings. Muscle activation data were collected from the medial gastrocnemius and anterior tibialis of both legs using surface electromyography electrodes. Two load cells in the platform measured the load exerted by each foot during the takeoff phase of the jump. Data were collected in 2 preflight sessions, on landing day (Shuttle only), and 1, 6, and 30 days after flight.

RESULTS AND CONCLUSION

Many of the astronauts tested were unable to maintain balance on their first postflight jump landing but recovered by the third jump, showing a learning progression in which the performance improvement could be attributed to adjustments of strategy on takeoff, landing, or both. Takeoff strategy changes were evident in air time (time between takeoff and landing), which was significantly reduced after flight, and also in increased asymmetry in foot latencies on takeoff. Landing modifications were seen in changes in ground reaction force curves. The results demonstrate astronauts' adaptive capabilities and full performance recovery within days after flight.